



CATHODIC ARC DEPOSITION TECHNOLOGY

Environmentally Friendly Vacuum Plating Deposition System Produces Superior Product

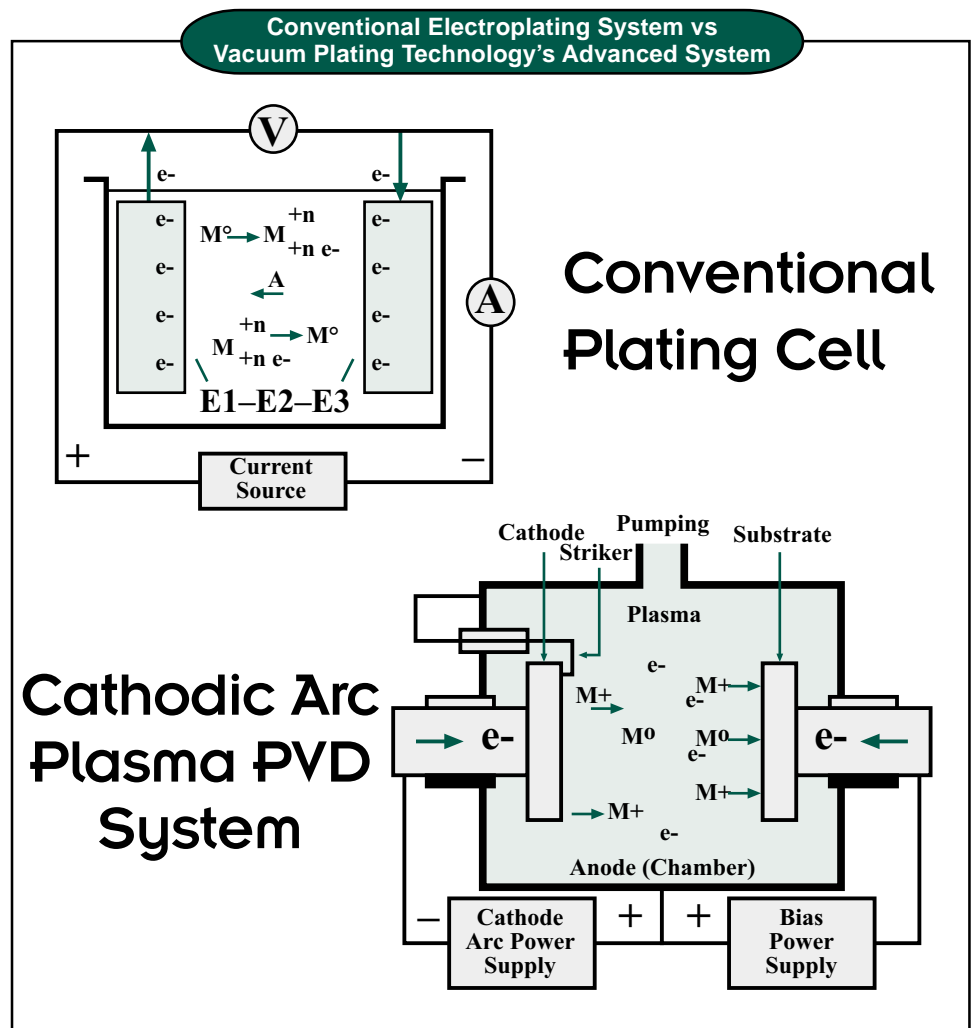
Benefits

- ◆ Provides lifetime coatings with superior finish properties
- ◆ Saves energy as a result of thinner coatings
- ◆ Uses no water, has no emissions, and produces only minute amounts of solid waste

Applications

Metal thin-film coatings of zirconium nitride, titanium nitride, and chromium on a wide variety of substrates.

Electroplating, a coating technology, is used to apply a finish to various products. The electroplating process deposits a coating—often metallic—on the cathode surface while the anode dissolves, replenishing the positive ions in the solution. The electroplating cell contains an electrolyte solution, often a salt of the plating metal. Materials such as steel, nickel, plastics, and ceramics can be electroplated with chromium, cadmium, nickel, and other metals.





The chromium coating is popular because of its color, high reflectivity, and resistance to scratches and corrosion. However, because of environmental and health concerns with hexavalent chromium in the chromium plating baths, alternative coating technologies are needed.

Vacuum Plating Technology Corporation has developed a coating process that can achieve decorative as well as functional coatings while eliminating hexavalent chromium, other toxic chemicals, and VOC emissions. The new process is a cathodic arc plasma (CAP) physical vapor deposition (PVD) system. The arc spots are ignited, starting the erosion of the cathode. Metal ions are emitted from the cathode by the arc spots that traverse the surface. A cloud of plasma is formed through evaporation of the arc spots, forming the coating on the substrate. The new system offers a high degree of versatility; provides a variety of coating finishes, multiple coating colors, and thinner coatings; and can coat large-area, three-dimensional objects.

Partnership with the NICE³ Program

Vacuum Plating Technology's CAP system has been operating since 1994 and was commercialized in 1995. In developing its system, Vacuum Plating Technology received a grant in 1995 under the U.S. Department of Energy's NICE³ (National Industrial Competitiveness through Energy, Environment, and Economics) Program and funding from the California Energy Commission. That funding enabled Vacuum Plating Technology to automate and refine the controls and to go from a pilot phase to a fully commercial phase.

Under the NICE³ grant, Vacuum Plating Technology successfully designed an automated control system. Compared with a manual system, the automated system reduces labor costs for highly trained system operators and training costs from a high turnover rate of personnel.



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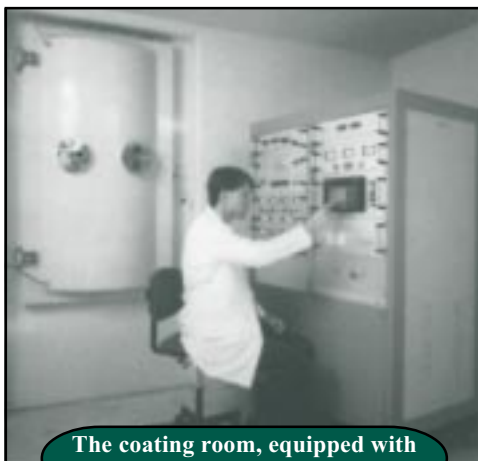


Project Partners

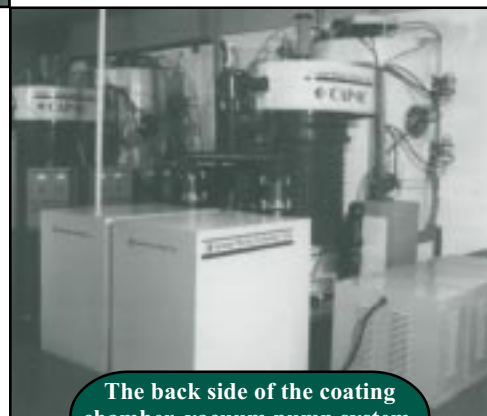
- ◆ Vacuum Plating Technology Corporation
San Jose, CA
- ◆ California Energy Commission
Sacramento, CA

Benefits of the CAP System

The CAP system enables PVD processes to provide a wide range of applications. The CAP system's versatility comes from its ability to tailor the bonding transition zone between the substrate and film to provide a good match of mechanical properties with strong adhesion and low residual stress. The result is that various coating materials can be applied to various materials. Coating materials include titanium nitride, zirconium nitride, chrome, and chromium nitride. Substrate materials include brass, zinc, aluminum, steel, and plastic. The CAP system also allows the deposition rate to vary from nanometers per minute to tens-of-micrometers per minute, depending on the desired film morphology, the substrate temperature limitations, and the coating material.



The coating room, equipped with coating chamber and control panel.



The back side of the coating chamber, vacuum pump system, and power supply system.



The CAP system also improves the ionization efficiency over other PVD processes, enhancing the coating's adhesion and density. Also, the CAP system's efficiency (70%) is dramatically higher than other PVD processes, which have sputtering and evaporation problems that result in an efficiency of 2% to 8%.

The CAP system produces parts at a lower cost than current technology because of a combination of less material, energy, and labor used, lower maintenance costs, and smaller floor space requirements. While the CAP system's startup cost is high because the vacuum equipment costs from \$600,000 to \$700,000, the costs are expected to decrease as technology advances are achieved with this relatively new system. The operating costs of the CAP system and traditional processes are similar, but the CAP system eliminates the expenses and problems associated with pollution control and waste treatment.

Waste solvents, over-spray paint sludge, and solid waste also are reduced using the CAP system. Process water is not used; therefore, wastewater treatment is not needed. CAP produces longer-lasting products, which also reduces product waste generated from conventional electroplating products.

Commercialization Continues

Through 1999 Vacuum Plating Technology has sold four units for use in the United States and four units for foreign markets. In addition Vacuum Plating Technology continues to contract services using two units at its plant in California. Life Time Coating Inc. in Illinois recently bought a second unit and two other units are in use at Global Finishing and Akashic Inc. in California.

NICE³ PROGRAM

NICE³ – National Industrial Competitiveness through Energy, Environment, and Economics: An innovative, cost-sharing program to promote energy efficiency, clean production, and economic competitiveness in industry. This grant program provides funding to state and industry partnerships for projects that demonstrate advances in energy efficiency and clean production technologies. Awardees receive a one-time grant of up to \$525,000. Grants fund up to 50% of total project cost for up to 3 years.

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